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Combinatorial Synthesis and Discovery of PEMFC Electrocatalysts on a Scaled Powder Production Platform

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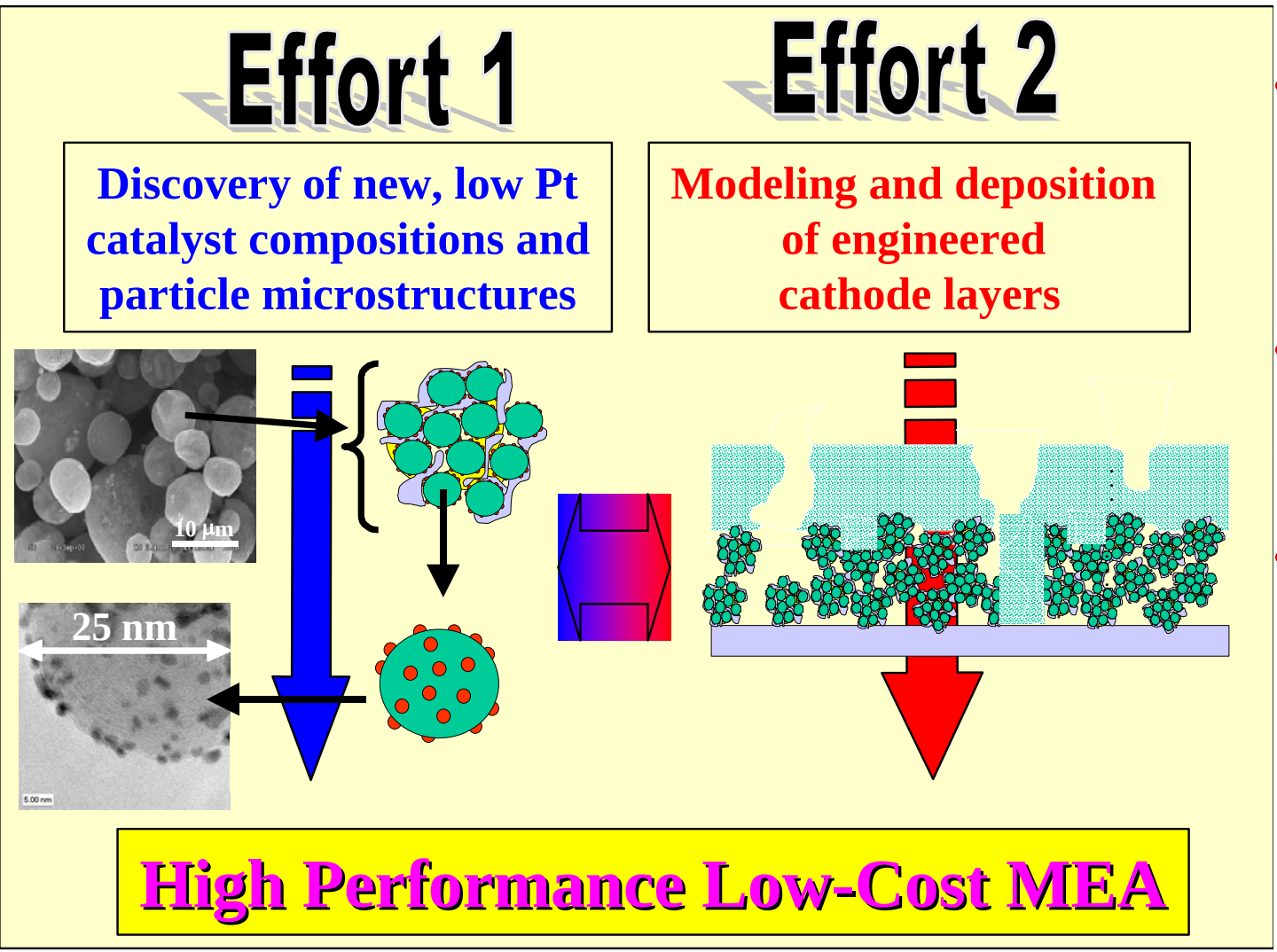
Cabot Superior MicroPowders, USA

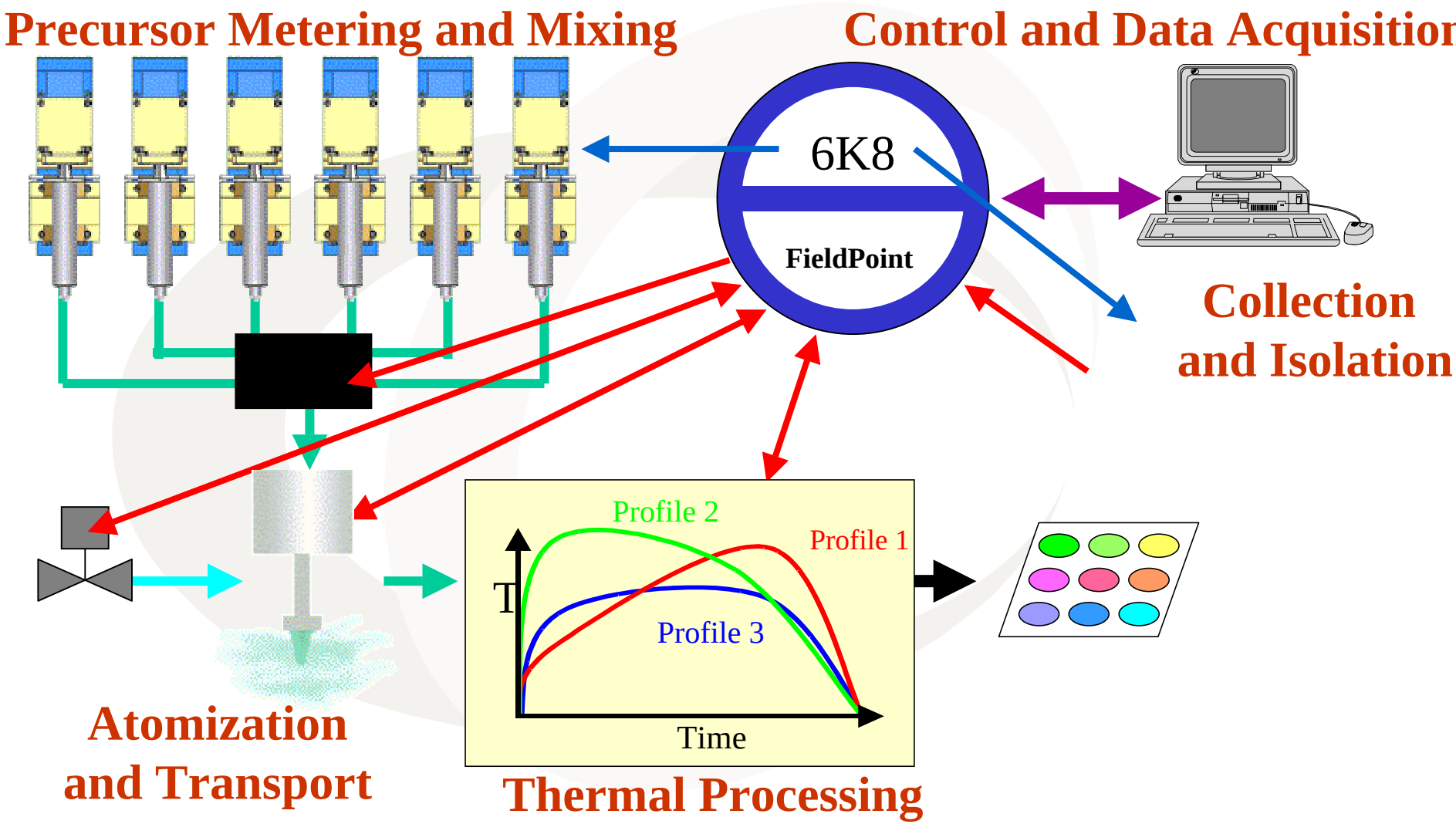
Development of High-Performance, Low-Pt Cathodes Containing New Catalysts and Layer Structure



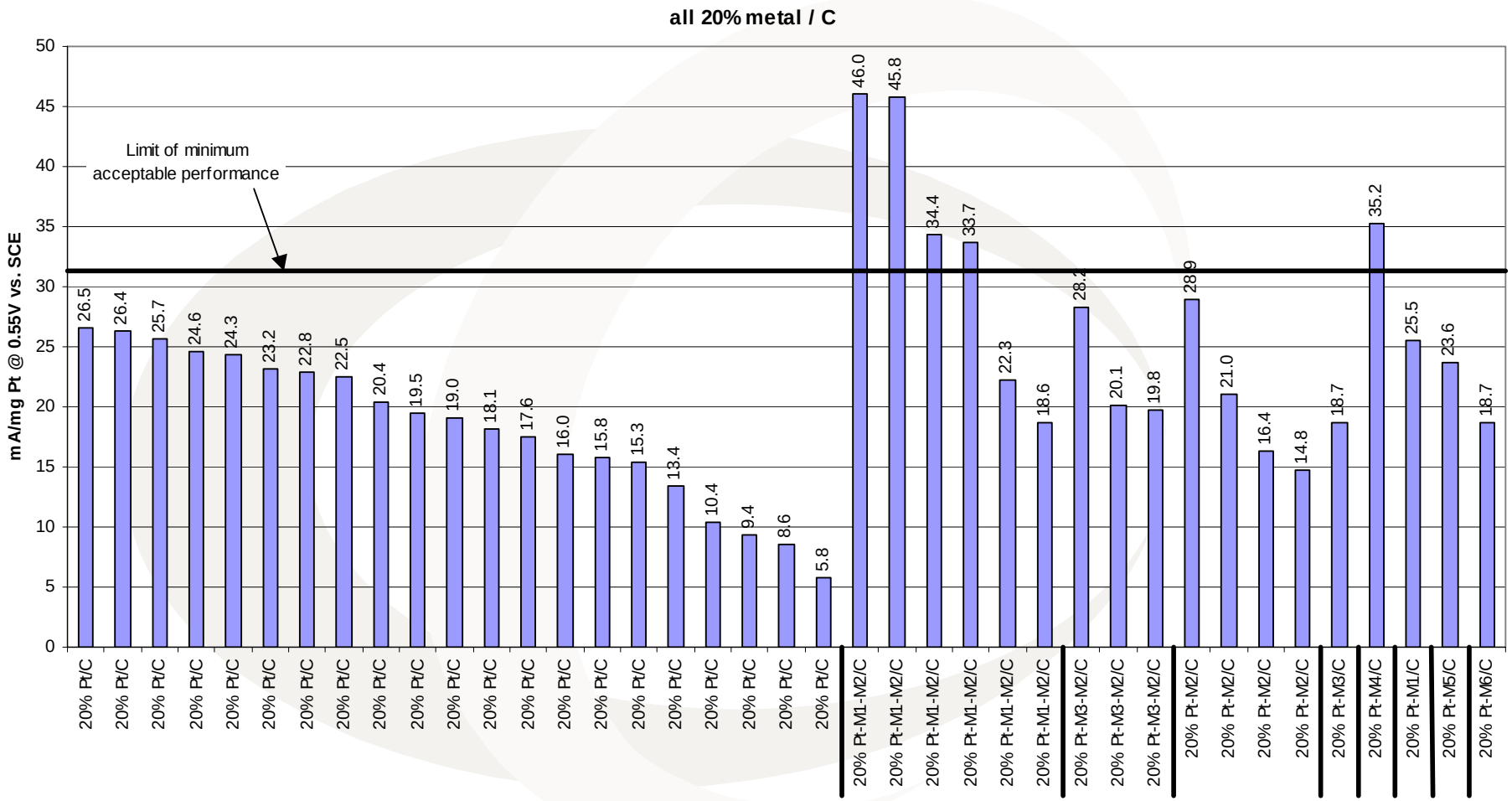
- **Effort 1:**
  - *CSMP*
  - *DuPont Fuel Cells*
- **Effort 2:**
  - *CSMP*
  - *CFDRC*
- **Short Stack Testing:**
  - *GM*
  - *Partnerships*

CABOT
Superior
MicroPowders

From Design to Equipment



High Throughput Screening Data for CSMP Electrocatalysts



CABOT Superior MicroPowders

DUPONT The miracles of science

DuPont Fuel Cells

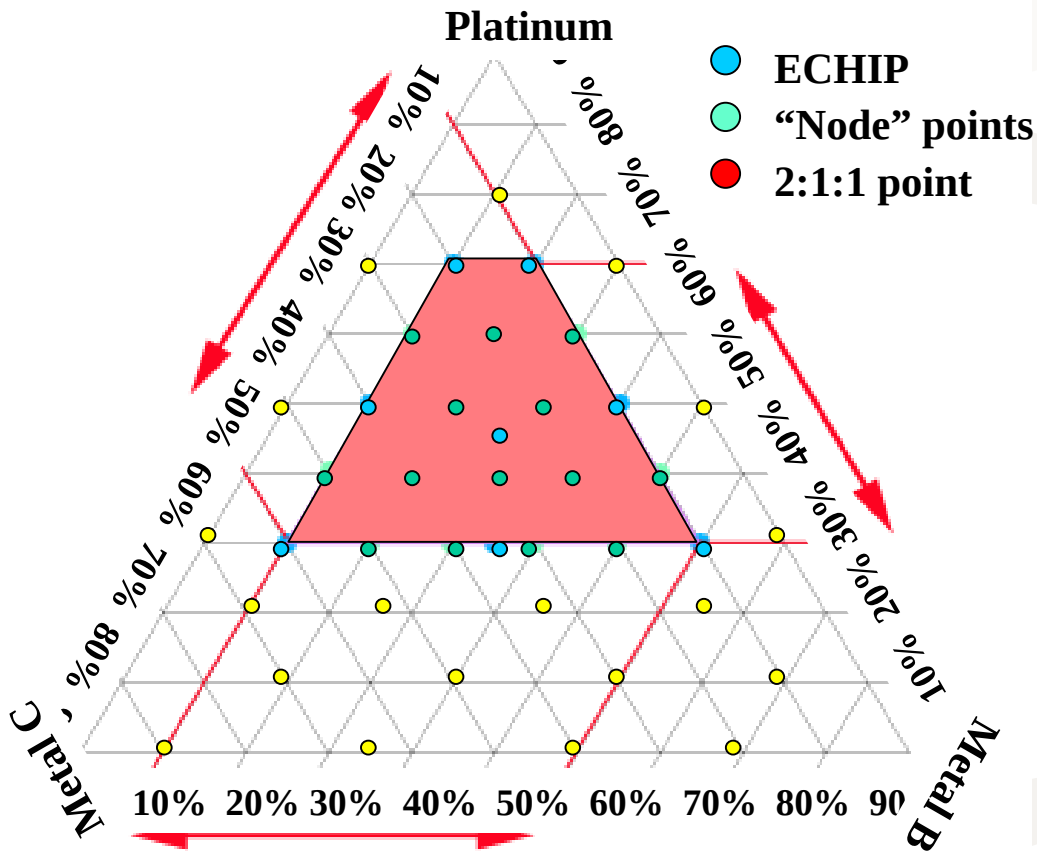
"... powered by DuPont"

Electrocatalyst Scale Up

Production
1,000's Kg
range

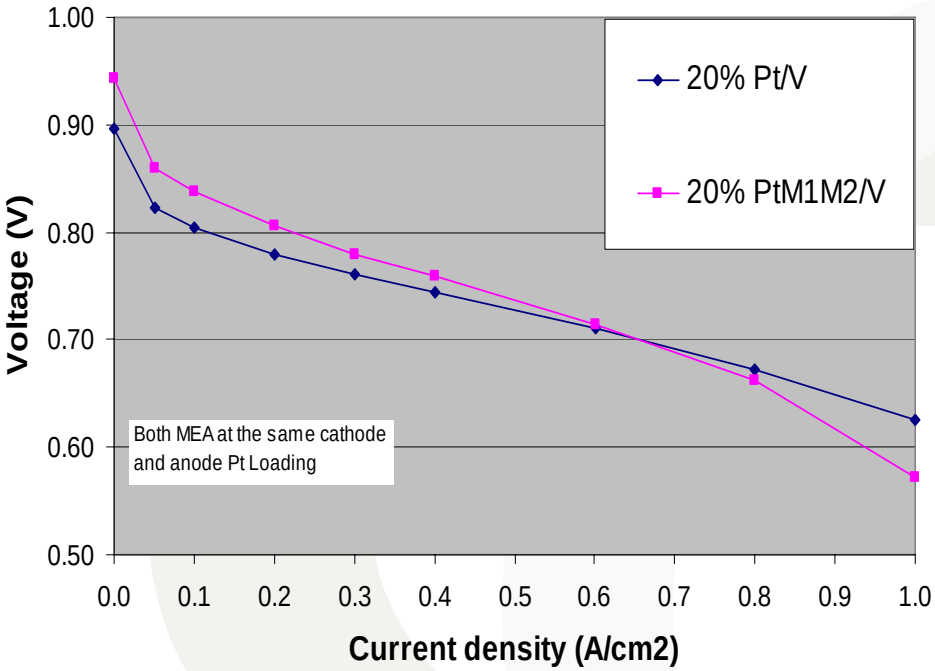
Combinatorial
100 mg range

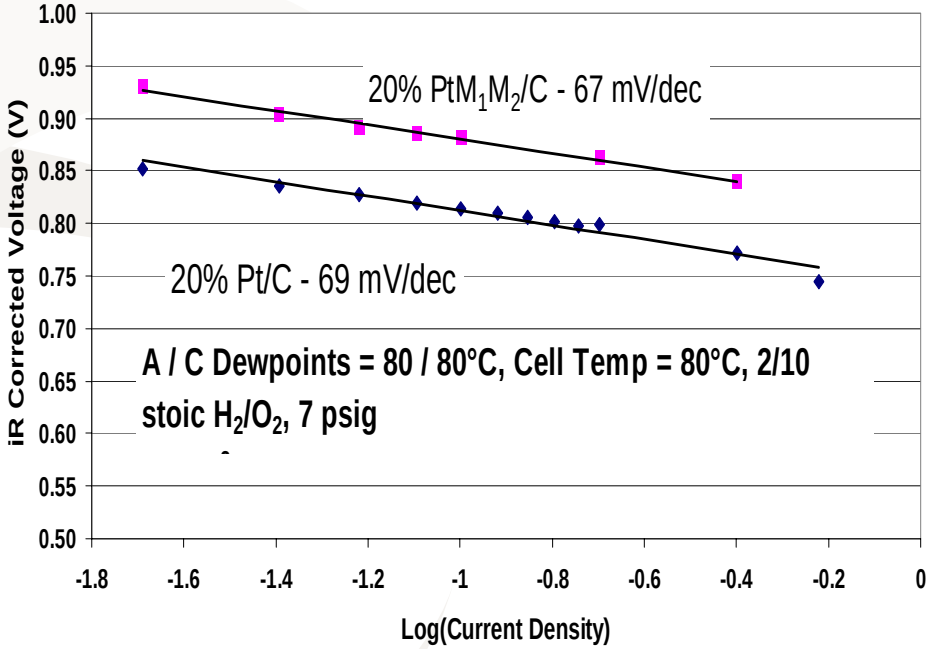
Selection of Composition and Structure Targets



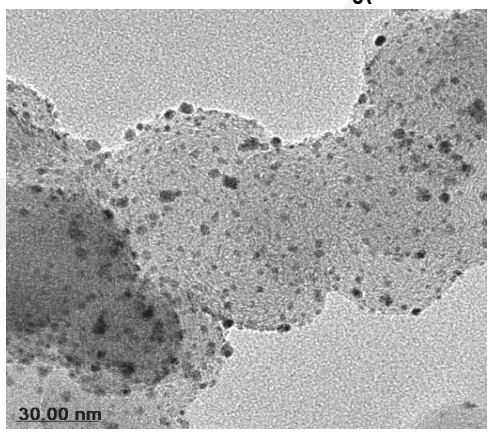
- ***Cost of components*** - raw materials, precursor cost
- ***Cost of manufacturing*** (precursors, processing steps) - fab cost
- ***Demonstrated performance advantage*** or possible one based on established general trends
- ***Long term stability***
  - stable in acidic media/resistant to corrosion
  - sustainable performance at high potentials
  - sustainable dispersion of the active phase

Characterization of Pt-alloy Electrocatalysts

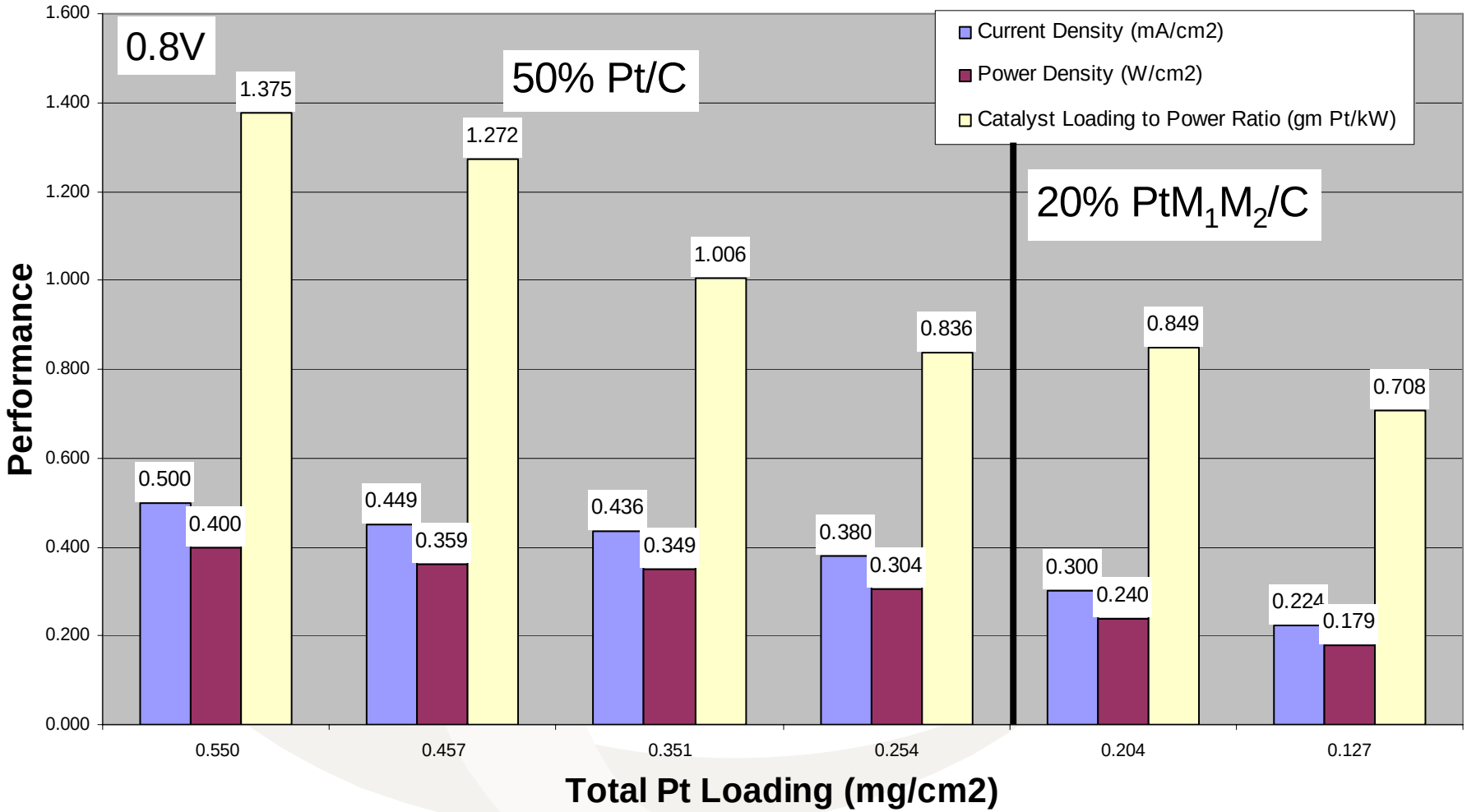




Single MEA Performance Data 80 C, 1.5H$_2$/2.5air at 1A/cm^2, 100% RH, 30 psig, 15 min/point

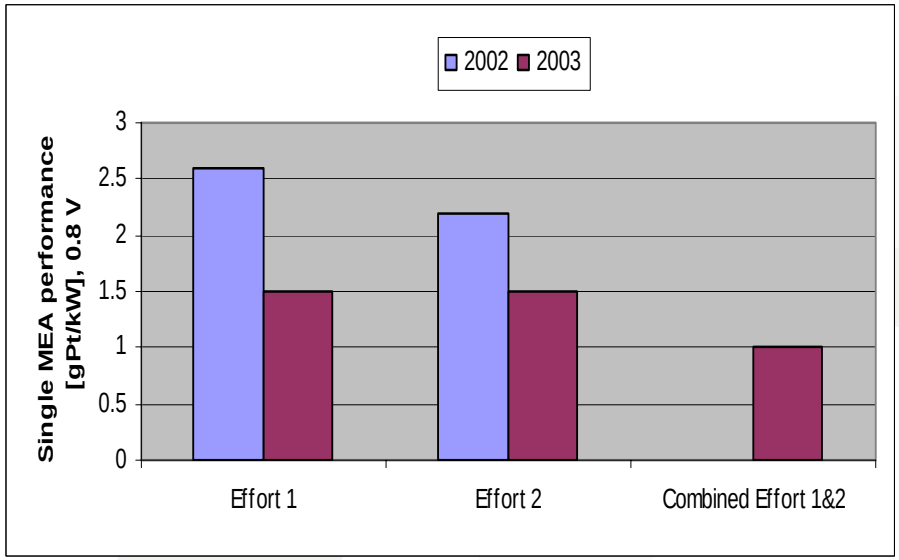


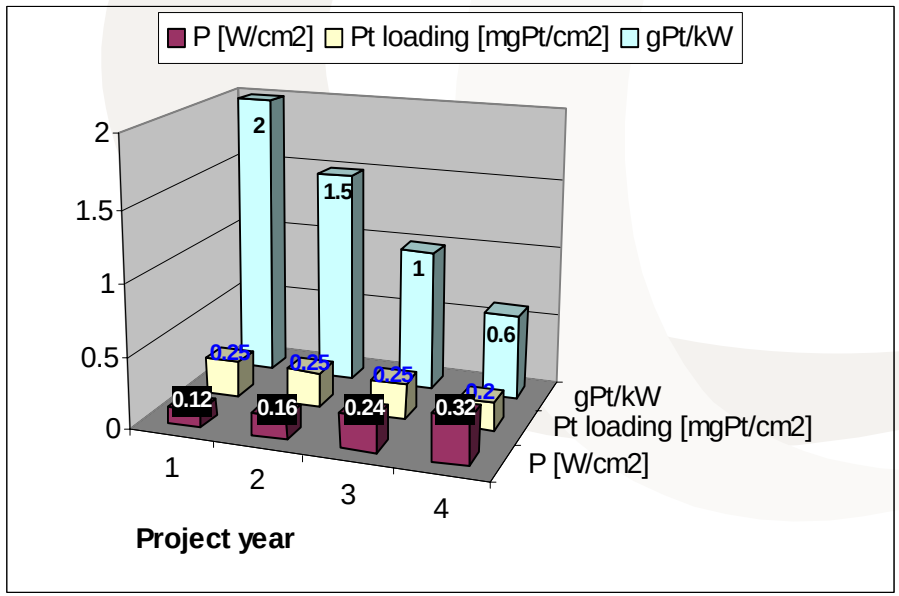
MEA Structure Optimization



Single MEA Performance Data
80 C, 1.5H_2/2.5air at 1A/cm², 100% RH, 30 psig, 15 min/point

Combined Effort 1 and Effort 2 Status vs. Performance Targets





- **Effort 1:** Ternary alloy catalyst performance improved from **2.6 gPt/kW to <1.5 gPt/kW**
- **Effort 2:** MEA structure development yields improvement from **2.2 gPt/kW to <1.5 gPt/kW**
- **Combined best alloy catalyst and best MEA structure result in performance of <1 gPt/kW**

Summary and Acknowledgements

- **Spray-based Combinatorial Powder Synthesis System completed**
- **Successful synthesis of alloy composition demonstrated and scaled up**
- **Screening of large number of compositions in progress**
- **Acknowledgements**
  - DOE OTT, Award DE-FC0402AL67620, Topic 1A1
  - DOE Program Manager: JoAnn Milliken, Valri Lightner
  - CSMP, DuPont Fuel Cells and CFDRC for cost share funding
  - The whole CSMP team and especially: Bogdan Gurau, Jim Brewster, Jenny Plakio, Heath Quiggle, Tomas Wood, Bryan Apodaca, Henry Romero
  - DuPont Fuel Cells: JoAnn Schwartz, Lin Wang,Keith Tomey, Richard Okine